

MANAGEMENT OF LIQUID NITROGEN

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Amendment History

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Please note:

If you require a copy of this procedure in an alternative format (for example Large Print, Easy Read) or would like any assistance in relation to the content of this policy, please contact the Human Resources (HR) team on 01803 656680.

1. Purpose and Application

The purpose of this procedure is to define the management requirements for the storage and handling of liquid nitrogen so that the risks involved are reduced as far as reasonably practical to ensure the safety and health of personnel using liquid nitrogen.

It also provides guidance on the standards and systems required to ensure compliance with legislation and the records to be maintained.

2. Responsibilities

The Trust Health and Safety Policy sets out the responsibilities for Chief Executives, Directors, Managers, Employees and Working Groups for all health and safety policies, procedures and working guidelines and have the same relevance to this procedure.

Directors, senior managers and line managers must ensure that this procedure is followed in all areas under their control and ensure that adequate resources are made available to implement this procedure effectively.

2.1 Line Managers

- The responsibility for ensuring that a Risk and COSHH assessments are carried out is a function and responsibility of Line Management, this task maybe delegated to a competent person or persons
- Line Managers of departments that use or store liquid nitrogen must familiarise themselves with work involving the use of or exposure to harmful substances
- Shall ensure that all staff that use liquid nitrogen receive appropriate supervision, information, instruction and training on in its safe handling and use.

2.2 All Staff

All employees are expected to take reasonable care to ensure the safety of themselves, their colleagues, patients and members of the public. Staff are responsible for complying with all COSHH/Risk assessments and policies.

3. Hazards

3.1 Asphyxiation

The release of gas can cause a dramatic change in the surrounding atmosphere. Liquid Nitrogen rapidly vaporises to gas with about 700 times the liquid volume. By displacing air the gas may kill by asphyxiation. When the oxygen concentration in air is sufficiently low, a person can become unconscious without any warning symptoms.

All cryogenic liquid storage vessels will produce gas through the vacuum insulation. Generally

1% to 2% of the liquid content is converted to gas in 24 hours. When non-pressurised vessels are used this gas will enter the atmosphere creating a potential hazard in a confined space.

3.2 Cryogenic (cold) burns

Contact with liquid nitrogen or associated extremely low temperatures surfaces can freeze flesh rapidly.

When spilled on a surface the liquid tends to cover it completely. The gas issuing from the liquid is also extremely cold. Delicate tissue, such as eyes, can be damaged by exposure to cold gas alone. Unprotected body parts contacting objects cooled by liquid nitrogen may stick fast. This may result in injuries by flesh being torn whilst attempting to withdraw from the object. Prolonged inhalation of cold vapor or gas can damage the lungs. Cryogenic liquids and vapor can damage the eyes.

3.3 Use of lifts

Use of Lifts: There is a small risk that should a person remain in a closed lift for a prolonged time any venting gases may reduce the oxygen levels sufficiently to cause harm. However to eliminate these risks the following practice should be followed when transporting dewars:

- No one should accompany the dewar inside a lift
- One person should send the dewar and another should be waiting to receive the dewar from the lift
- Use controlled goods lifts whenever possible. Do not use public use lifts. If this is not possible, a suitable qualified person must be at every floor if lift covers multiple floors to ensure no person can enter lift whilst Liquid Nitrogen is being transported)

4. Procedures

4.1 Use

A suitable and sufficient risk assessment of the risks of shall be undertaken and recorded by the department using liquid nitrogen.

Liquid Nitrogen is only to be used in well-ventilated areas where this is not possible static oxygen depletion monitors must be present.

All personnel involved in the filling, handling, use or transportation of liquid nitrogen dewars shall:

- Be aware of, and trained in, the hazards of liquid nitrogen
- Wear appropriate hand, eye, feet and body protection when handling full or empty dewars

- Not fill, use or transport any dewar with a damaged neck, wall trunnion support, base support or wheels
- Ensure that dewars are correctly and clearly labeled for nitrogen service before filling
- Only use dewars which are correctly and clearly labeled
- Only transport dewars which are correctly labeled for transport
- Be adequately trained in the handling of liquid nitrogen dewars
- Know what actions to take in the event of a liquid spillage
- Know what actions to take if an incident results in a cold burn or asphyxia casualty

4.2 Training

All personnel handling Liquid Nitrogen must be fully informed regarding the hazards; in particular Oxygen deficient atmospheres, cold burns and emergency procedures. The training must be arranged to cover those aspects and potential hazards that the particular person is likely to encounter. Training should cover, but not necessarily be confined to, the following subjects for all personnel:

- Potential hazards of Liquid Nitrogen
- Site safety rules
- Safe handling procedures e.g. method of dispensing, sample retrieval, transportation
- Use of protective clothing
- First aid treatment for cryogenic burns
- All training must be formally recorded (ESR) with refresher training undertaken as required

4.3 Storage

Ideally a covered external storage facility should be provided, but the location for the storage and use of liquid nitrogen must be chosen in the following order of preference:

- In a ventilated room sealed from other areas of normal occupancy
- At, or above, ground level adjacent to an outside wall as far as possible from normal workstations

- At above, ground level, as far as possible from normal workstations
- Liquid nitrogen must not be stored or used below ground level or in corridors. All pipe-work and valves must be labelled or marked for functions. All vessels and equipment must be commissioned and handed over by a competent person

All vessels, work equipment, furniture and other items must be organised in such away as to allow staff, and other users of the space, adequate means of access and egress.

Storing single dewars of up to 25L in rooms is considered acceptable with adequate ventilation. However the storage of large numbers of small dewars or dewars over 25 litre capacity may require additional precautions to be taken. In these circumstances consideration should be given to: the size of the room; the storage conditions: ventilation levels: and, the possible use of low oxygen level alarms. Dewars must not be stored in sealed rooms (e.g. Walk in refrigerated rooms) because the reduced ventilation may be inadequate to mitigate against spillage and general evaporation.

Use only containers designed for low-temperature liquids. Cryogenic containers (e.g. Dewar flasks) are specifically designed and made of materials that can withstand the rapid changes and extreme temperature differences encountered in working with liquid nitrogen. Even so, these special containers should be filled slowly to minimise the internal stresses that occur when any material is cooled.

- Do not cover or plug the entrance opening of any liquid nitrogen refrigerator or dewar
- Do not use any stopper or other device that would interfere with venting gas

Cryogenic liquid containers are generally designed to operate with little or no internal pressure inadequate venting can result in excessive gas pressure which could damage or burst the container. Check the unit periodically to be sure that the venting is not restricted by accumulated ice or frost.

4.4 Labeling

Liquid nitrogen dewars shall be clearly and adequately labeled. The Label includes:

- Basic safety information
- Transport labelling information

4.5 Maintenance of equipment

All large capacity storage equipment (25 litres or larger) should be subject to 6 monthly maintenance checks. All containers should be visually inspected prior to use.

4.6 Personal Protective Equipment (PPE)

The following PPE, manufactured to an approved standard shall be worn when handling or decanting liquid nitrogen:

- Eye protection - A face visor is to be used
- Hand Protection - Non-absorbent, thermal protective gloves which are specifically designed for cryogenic use, with close fitting ribbed cuffs to prevent liquid nitrogen from spilling inside the glove. Never put hands (even in the best gloves) into liquid nitrogen
- Protective footwear – Safety shoes/boots with reinforced toe protection and a sewn in tongue
- Body protection - A splash resistant apron

4.7 Transport

Dewars must be checked for damage before transporting and kept upright at all times. Tipping the container or laying it on its side can cause spillage of liquid nitrogen. It may also damage the container and any materials stored in it. Rough handling can cause serious damage to dewars. Dropping the container allowing it to fall over on its side, or subjecting it to sharp impact or severe vibration can result in partial or complete loss of vacuum.

To protect the vacuum insulation system, handle containers carefully. Do not 'walk', roll or drag Dewars across a floor. Large units are heavy enough to cause personal injury or damage to equipment if proper lifting and handling techniques are not used. When using lifts this task should be undertaken by 2 members of staff.

Due to the potential hazards from the escape of gas or spillage of very cold liquid nitrogen should not be transported on vehicles where the load space is not separated from the driver's compartment. Drivers must be adequately trained in the properties of liquid nitrogen, aware of the potential hazards of the load and know what to do in the event of an accident or an emergency.

Before transporting product containers, ensure that they are firmly secured.

4.8 Disposal

Never dispose of cryogenic liquids down the drain. Ordinary materials may not be able to withstand cryogenic temperatures without failure. Laboratory plumbing is a common example. Allow waste liquid nitrogen to evaporate naturally in a fume hood or, preferably, pour the liquid slowly on gravel or bare earth, from which other people are excluded, where it can evaporate without causing damage. Do not pour the liquid on the pavement.

4.9 First Aid

Skin / Eye Contact:

- Immediately flush thoroughly with copious quantities of tepid water (the water must not be hotter than 44C)
- DO NOT apply any form of direct heat
- DO NOT rub affected parts either before or after warming
- Move patient to a warm place (22C)

The aim is to slowly raise the temperature of the affected area back to normal. For minor injuries make the injured person comfortable and loosen any clothing that may restrict blood circulation. **Do not pull clothes away from burned or frozen area.**

Use a sterile burn dressing to protect the injury and to get the patient to the Hospital casualty department.

DO NOT permit smoking or alcohol consumption or give analgesics (aspirin, paracetamol etc).

Anoxia: If a person seems to become dizzy or loses consciousness while working with liquid nitrogen, move to a well-ventilated area immediately and seek medical attention. If medical attention is not immediately available, arrange for the casualty to be transported to a Hospital casualty department without delay. Ensure that the ambulance crew and the hospital are advised of details of the accident and of the first aid treatment already administered.

4.10 Action in event of a spillage

- Evacuate all personnel from the area likely to be affected by the liquid and the evolved nitrogen gas
- Pay particular attention to pits, basements, cellars and stairwells because the cold gas will collect in those areas. Try to prevent the gas flowing along the ground into such areas by closing doors
- Take appropriate action to ensure that the ventilation system does not spread the nitrogen to other areas
- Open exterior doors and windows to encourage evaporation of the liquid and safe dispersal of the nitrogen gas
- Allow the liquid to evaporate naturally
- The evolved gas will be very cold and will create a cloud of condensed water vapour restricting visibility. Do not allow anyone to enter this cloud
- Do not allow anyone to enter the area until you are sure that the nitrogen gas has all dispersed and that the air is safe to breathe. If in doubt, use an oxygen monitor to check oxygen levels

4.11 Action in the event of an ice plug forming

If an ice plug forms there is a danger that:

- It will detach at high velocity when the dewar pressure rises
- It will cause sufficient pressure build up in the dewar to cause it to rupture

Extreme caution shall be exercised if an ice plug is found. All personnel, except the minimum number required to deal with the incident, should be evacuated from the area and the supplier contacted.

5. References

The following references and further reading are applicable to this document:

- Health and Safety at Work act 1974
- The Control of Substances Hazardous to Health Regulations 1999 (as amended)
- The Personal Protective Equipment at Work Regulations 1992
- BCCA Code of Practice CP30